Near Field Heterodyne X-Ray Speckles

Marzio Giglio[a], Roberto Cerbino[a], Marco A.C. Potenza[a], Luca Peverini[b], [a]*Dipartimento di Fisica and INFM, Università degli Studi di Milano, Italy.* [b]*ESRF, Grenoble, France.* E-mail: marzio.giglio@fisica.unimi.it

We report on the observation of stable, low contrast speckles obtained with synchrotron radiation by simply letting static scattered X-Ray radiation fall onto a high resolution camera.

The speckles have circular symmetry, their diameter being typically a few microns. Their size does not change as the sample to sensor distance is varied between few millimeters up to several centimeters. It is argued that the speckles are due to a self-referencing scheme where both the scattered radiation and the heterodyne local oscillator originate from the same rapidly changing, local coherent beam patch.

It is suggested that the X-Ray speckles are of the same type of those obtained with the newly reported optical Near Field Scattering method that has been shown to be equivalent to static light scattering, as the scattered intensity distribution can be retrieved by the statistical analysis of the speckle intensity distribution.

The simple lensless arrangement described above could be used as a new ultra low scattering method operative at extremely small scattering angles where conventional X-Ray scattering methods fail.

Speckle generated X-Ray scattering data are reported for the cellulose acetate filters that exhibit a quasi spinodal structure. A minimum appears at q=0, and an anticorrelation peak at finite wavevectors is also reported. The data are in good qualitative agreement with light scattering data from the same samples.

Keywords: small-angle scattering, Fourier optics, fractals